

# GENERAL NOTES

The National Science Foundation (NSF) sponsors a series of surveys to collect information on the financial and human resources devoted to research and development (R&D). In this report, NSF survey data on the various sectors of the U.S. economy—industry, government, academia, and selected nonprofit organizations—are aggregated so that the components of the overall R&D effort are placed in a national context. Information presented in *National Patterns* includes the following:

- the level of R&D expenditures;
- the sources of such funds;
- the sector or organization performing the R&D;
- the character of work undertaken (i.e., whether it is basic research, applied research, or development);
- the states in which R&D is undertaken in the United States;
- the number of scientists and engineers employed in R&D; and
- international comparisons with the U.S. effort.

The national totals reported here incorporate data available from several Division of Science Resources Studies (SRS) surveys as of August 1998, as well as projections to cover the entire year. This report, including the appendix tables as separate spreadsheet files, will be made available on the Internet as well, at <<http://www.nsf.gov/sbe/srs/nprdr/start.htm>>.

These notes provide a brief introduction to the concepts used in the report. Important changes and revisions from previous *National Patterns* reports also are highlighted. For complete definitions, descriptions of projection methodologies, and references to the underlying survey reports, see appendix A.

## PERFORMER REPORTING BASIS

SRS annually surveys Federal Government agencies, industry, and academia. Respondents in each sector indicate the amounts they spend on R&D in their own sector and the sources of these funds. National historical totals are based on data reported by performers because

they are in the best position to: (1) indicate how much they spent in the actual conduct of R&D in a given year; (2) classify their R&D by character of work; and (3) identify the sector of the economy in which their financing originated. The consistent use of performer reporting reduces the possibility of double-counting and conforms to international standards and guidance.

There are exceptions to the use of performer-reported data. The last complete survey of the nonprofit sector was conducted in 1973, although a survey of nonprofit R&D activity is being undertaken in 1998–99. Since 1973, informal surveys of this sector have been undertaken periodically. Nonetheless, estimates of the R&D performance by nonprofit organizations reported here are generally based on (1) Federal agency reporting of Federal funding to the nonprofit sector and (2) R&D performance trends in the other non-federal sectors.

In addition, NSF sponsors only occasional surveys of state government agencies; the last two surveys covered fiscal years (FYs) 1987–88 and 1995–96. Consequently, the national R&D time-series totals exclude estimates of state agencies' intramural R&D performance. State funds for R&D reported by other sectors of the economy, however, are included in the respective R&D performance totals.

One byproduct of the decision to use performer-reported data is that the federally funded R&D performance totals presented in *National Patterns* differ from the Federal R&D funding totals reported by the Federal agencies that provide the funds. One reason for these differences is that performers of R&D often expend Federal funds in a year other than the one in which the Federal Government provides authorization, obligations, or outlays. (For definitions of these terms, see appendix A.) During the past several years, differences between Federal R&D funding reported by performers and by funding agencies has widened. These trends are documented in Appendix A, tables A-1 and A-2.

## PROJECTIONS

Although respondents are continually given the opportunity to revise prior data, R&D totals for 1996 reported here are considered to be actual expenditures. Data reported for 1997 and 1998 are preliminary, in the

sense that 1997 data are based on preliminary reporting of information, and 1998 data are projections made during the summer of 1998 based on information available at that time. The series presented in this *National Patterns* updates projections for 1995 and 1996 that were reported in *National Patterns of R&D Resources: 1996*.

To the greatest extent possible, this report incorporates data for 1998 R&D programs contained in the administration's 1999 budget proposal. The text notes explicitly where these data are used. The budget, however, does not contain estimates on the detailed disaggregation reported in *National Patterns*; most importantly, it includes very little information on the economic sectors receiving the Federal funds. Consequently, Federal agencies' R&D performance for 1997 and 1998 are derived from an NSF survey of 32 Federal agencies coinciding with the third quarter of FY 1997. The amounts reported for 1998 therefore reflect Congressional appropriations, apportionment, and reprogramming decisions as of that time.

R&D performance estimates for 1997 and 1998 for the other sectors of the economy are derived on the basis of three types of information: (1) survey information submitted early by some of the responding institutions, allowing for an early, partial picture of what the aggregate results might be once all survey responses are received; (2) responses by performers to questions about their future plans; and (3) statistical regression and time-series modeling techniques based on observed patterns of R&D expenditure by performers. The precise methodologies used for such estimation are explained in the forthcoming companion document, *Methodology and Procedures Underlying the National Patterns Report: 1998* (see Appendix A: Technical Notes).

## NEW FEATURES IN THE 1998 *NATIONAL PATTERNS* REPORT

**Consistent calendar-year basis for all data.** The previous *National Patterns* report of 1996 provided a combination of fiscal-year expenditure amounts for governmental and academic R&D, and calendar-year expenditure levels for industrial R&D and for R&D performed by other nonprofit organizations. Aggregates of these amounts were then taken, reflecting neither a precise fiscal-year nor calendar-year definition, but a general combination of both. Therefore, for greater consistency and clarity in measurement, and for ease of

calculation (especially in adjustments for inflation), all R&D levels for all performers have since been converted to a calendar-year basis. However, data on the budget authority of the U.S. Federal Government will continue to be in reference to fiscal years, for obvious reasons.

**More detailed information.** The current data provide more detailed information about R&D by performer, source, and character of work. For example, for federally funded research and development centers (FFRDCs) administered by industrial and nonprofit organizations, this report provides annual breakdowns of R&D by character of work, in contrast to the previous report, which contained only total R&D amounts for these performers. In addition, the new data include current-dollar and constant-dollar amounts for all components of national R&D by performer, source, and character of work, while previous data included constant-dollar amounts only for aggregates of these components by performer or source.

**Presentation of data in a database format.** Data in the previous report were organized entirely in terms of elaborate spreadsheet formats. Such spreadsheets will continue to be provided, but the new data will also contain, as an additional feature, Appendix Table B-6, which is a single, comprehensive spreadsheet file for 175 columns of data on national R&D components and related variables, covering the full time series 1953–98. Table B-6 is structured, in part, to facilitate the creation of a database file, through its importation into a database software package. The labeling of its columns (or “field labels”) have already been established in a simple, numerical structure. Those labels give data users the ability to find, quickly and easily, any historical data that may interest them, either in Table B-6 itself, or in any database file created from it.

**Symmetry of R&D tables with respect to type of performer and sources of funds.** Another new feature is that the first four appendix tables are symmetrically arranged to allow for direct comparisons of R&D data organized in two ways: (1) by performer first and then by source, or (2) by source first and then by performer. The first case effectively asks, “what type of organization performs the R&D, and for that type of performer, from what kinds of organizations does it receive its funding?” The second case effectively asks, “what type of organization provides funding for R&D, and to which kinds of performers does it provide those funds?” For further discussion of this feature, see Appendix A: Technical Notes.

**More extensive data.** Overall, this 1998 *National Patterns* report provides more extensive data on R&D expenditure levels and related variables than previous reports. Examples include:

- **Finer levels of detail on R&D expenditures.** This detail is provided through the addition of new data columns that did not previously exist, and through the creation of symmetric tables on source of funds by performer and on performer by source of funds (as described above).
- **Historical data on R&D expenditures by State.** Previous reports provided data on R&D by performer for each state, but only for the most recent year for which data were available, which in this report would be 1995. This report provides these data not only for 1995, but also for 1987, 1989, 1991, and 1993.
- **Greater detail on the industrial nonmanufacturing sector.** In previous *National Patterns* reports, all industrial R&D carried out in “nonmanufacturing” industries was treated as a single concept that was not subdivided into the various sectors within this broad industrial category. Owing to improvements in the Survey of Industrial Research and Development, R&D in nonmanufacturing is now subdivided into several components for the most current years of 1995 and 1996. These components include, for example: communications; electric, gas, and sanitary services; computer and data processing services; other business services; health services; and engineering and management services.

**Simpler presentation of dollar amounts and growth rates.** For the sake of clarity, the current *National Patterns* report now abides by the following guidelines:

- Within the text of the report, all reported dollar amounts are *nominal* amounts. Dollar amounts in constant 1992 dollars are provided in many of the appendix tables.
- All growth rates reported, unless otherwise specified, are in *real* terms, i.e., adjusted for inflation, and they refer to the average rate of growth per year.

**A New Section.** A new section, “Why Statistics on R&D Expenditures Are Collected and Analyzed” was

added for background. This section might also help readers interpret and analyze the information provided in the *National Patterns* report.

**A listing of references to published studies that have relied upon *National Patterns* data.** As simply a few examples, the following recent publications were found in the *Social Science Citation Index* and other sources as relying on *National Patterns* reports:

Brennan, M.; J.R. Long and P. Zurer, “Facts and figures for chemical R&D,” *Chemical and Engineering News*, October 19, 1998, 52–82.

Jankowski, J., “R&D: The foundation for innovation . . . changes in U.S. industry,” in *Trends in Industrial Innovation: Industry Perspectives and Policy Implications*, Sigma Xi, The Scientific Research Society, Inc., Research Triangle Park, NC, 1998, pp. 201–211.

Kortum, S.S. “Research, patenting, and technological change,” *Econometrica* 65: (6) 1389–1419, Nov. 1997.

Larson, C.F. “Helping innovation with research-on-research,” *Chemtech* 27: (12) 12–16 Dec, 1997.

Mowery, D.C. “The changing structure of the US national innovation system: implications for international conflict and cooperation in R&D policy,” *Research Policy*, 1997, 639–654.

Moore, K. “Organizing Integrity - American science and the creation of public-interest organizations, 1955–1975,” *American Journal of Sociology*, 1996, Vol. 101, Iss 6, pp 1592–1627.

Wei, C.C., “The current status of R&D activities in Taiwan,” *International Journal of Technological Management*, 1997, 13: (5-6) 563–570.

However, many other published studies have also relied on *National Patterns* data. In the near future, efforts will be made to create a much larger list, generated from reader feedback, which will be provided to readers as an additional appendix to the *National Patterns* report. As this list expands, it will be organized by general area of study, which would serve as a tool for colleagues studying the information provided in the *National Patterns* report. (See the appeal on the following page for reader feedback on this project.)

# REFERENCES TO *RESEARCH STUDIES* THAT USE *NATIONAL PATTERNS* DATA

## INSTRUCTIONS FOR HAVING US ADD A REFERENCE TO ONE OF OUR LISTS

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We would be grateful for any references that you could provide for us. You are welcome to tell us about your own published work or work published by others.

We are collecting and displaying these “references to research studies” for four reasons:

- To help researchers who are working on science-resource topics find each other and learn about each other’s results;
- To see how our data are being used and studied, so that we may develop them to better meet our customers’ needs;
- To learn, and help inform others, about what has actually been discovered with regard to science resources; and
- To better contribute to the literature on science resources (both scholarly and publicly-oriented literature) through increased interaction with the rest of the research community.

### *Criteria for being listed as a reference. . .*

We will list *all* references that meet the following criteria, and will *not* make any value judgments regarding the quality of the research conducted.

The work in question must make *significant use* of data provided in the *National Patterns* report. That is, at least one of the main findings of the work (e.g., one of the key points made in a conclusion section) relies on the use of *National Patterns* data.

The work must be *published* in an outlet that is generally recognized as *contributing to* (and not just reporting on) the current body of knowledge on science resources or related topics. Such outlets include:

- Articles published in journals with significant recognition as contributors to scholarly thought. To make this requirement feasible in practice, we require that the journal meet at least one of the following two criteria:
  - It is included in either the Science Citation Index or the Social Science Citation Index of the Institute for Scientific Information (ISI).
  - It is a peer-reviewed, technical journal that is commonly held by major academic libraries.
- Books and monographs that are recognized by the Library of Congress as published works. This could include individual chapters of a book with contributions from multiple authors.
- Doctoral dissertations, also recognized by the Library of Congress.

### *How to inform us about a reference you would like us to list . . .*

Just send us the a copy of the work in the regular mail, along with a signed cover letter that provides a full reference to the work and a statement that your research did rely on *National Patterns* data. Earmark the pages and highlight the text where *National Patterns* data are mentioned. For books, dissertations, and monographs, you need only send one chapter that best demonstrates reliance on *National Patterns* data. Copies made on both sides of a page are acceptable.

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